

## Health Revolutionary: The Life and Work of Ancel Keys

**Unidentified Speaker:** At the age of 97, nearly 30 years after his retirement from the University of Minnesota, Ancel Keys was still writing, publishing, and accepting honors for his more than 60 years of pioneering research on nutrition and the causes of heart disease. Many today know Ancel Keys and his wife Margaret as the authors of the best selling book that introduced the Mediterranean diet to eaters around the world. But veterans of World War II would remember all too well another Keys project undertaken at the request of the U.S. War Department--K-rations, K for Keys. Those little brown boxed meals that became lunch and dinners to hundreds of thousands of hungry soldiers. In the closing years of that war, Keys conducted the first systematic studies on human starvation; research that proved invaluable in the effort to rehabilitate millions of starving war victims. But, no doubt, the greatest impact Ancel Keys has had on both the medical world and the man on the street results from his research on diet and heart disease; research that earned him the nickname Mr. Cholesterol, and a cover story in "Time" magazine. It's hard to believe that there was a time when five out of 10 American men succumb to heart disease, and yet no one, including those in the medical community, truly understood the underlying causes. Physiologist Ancel Keys thought he knew, but when he proposed his revolutionary hypothesis, he was doubted and criticized by many scientists around the world. He dedicated his

life's work to proving them wrong. Born in 1904 in Colorado Springs on the slopes of Pike's Peak, Ancel Keys was the only child of a teenage couple who had little formal education. When he was two, the family moved to California in search of work.

**Carrie D'Andrea:** The reason they all moved to California in the first place was that my grandmother's brothers had already moved there and my uncle, Lon Chaney, was already beginning his career as an actor.

**Unidentified Speaker:** The family settled in Berkley where Ancel spent his childhood. His interest in science began early, with nearly disastrous results during his eighth birthday party.

**Carrie D'Andrea:** During the party apparently he got bored and took his chemistry out into the back hall, and decided he was going to chloroform a fly. My grandmother arrived just in time to see him go flop down. He had chloroformed himself.

**Unidentified Speaker:** An average student bored with high school, Ancel decided to look for adventure beyond Berkley. He left a note for his mother and hitchhiked to Arizona where he found work in a cave shoveling bat dung, used in those days for fertilizer. With money in his pocket after three months work, he returned home, finished high school, and in 1922 enrolled at the University of California at Berkley. But after a year at Berkley, where he took a heavy load of tough courses including chemistry, physics, German, and Chinese, he was off again.

**Carrie D'Andrea:** One summer he decided that he would go to China, and he figured out the only way to go there was to get a job on a boat of some kind, and so he was hired on as manual labor shoveling coal into the furnace of the boat that went to China.

**Unidentified Speaker:** Ancel returned to Berkley and finished college in three years with high grades. A post college sales job at Woolworth's, which he described later as "intolerably dull," propelled him back to the University. Thus, in 1927, Ancel began graduate work at Berkley, and research at La Jolla's Scripps Institute, studying the physiology of fish. This led to a PhD in biology. Then off again, this time to Copenhagen in 1930, for a coveted post-doctoral fellowship studying with Nobel Prize winner August Krogh. Ancel's primary research topic was a question of how eels survived in both salt and freshwater. From there he went to England for a second PhD in physiology from King's College Cambridge. Even there, however, Keys wrote later, he had not yet found his place in research. But then in 1933, Keys received a job offer from the Fatigue Laboratory at Harvard University. There he turned his attention to studying the human body, especially under extreme conditions. On the frigid slopes of the high Andes, with the help of a small support team, Ancel spent 10 days measuring the effects of 20,000 feet of altitude on his own blood. This work resulted in Keys pioneering study of the oxygen-carrying capacity of the blood and the body's ability to adapt to high altitude. At 29, young doctor Keys had found his true research interest, the physiology of the human body.

**Unidentified Speaker 2:** The Nazi's are supposed to have a superman vitamin pill. The pill story is checked by Dr. Ancel Keys and his staff at the University of Minnesota.

**Unidentified Speaker:** It was 1939, and Europe's war was threatening to become America's. Ancel Keys had been at the University of Minnesota for just two years when he received an urgent telegram from the War Department. The assignment: to develop and test a food ration for parachute troops. The War Department seemed to have the crazy impression, Keys wrote later, that because he had done research at high altitude, he was qualified to design a ration to be eaten by men who had been briefly a few meters above ground. Keys had just formed a research unit, the Laboratory of Physiological Hygiene, at the urging of the Dean of Minnesota's School of Public Health. The University gave him space behind Gate 27 of the football stadium where he designed a warren of offices and laboratories literally right under the bleachers. There, he and the multidisciplinary team he assembled set to work developing the rations. The Army wanted a compact, nutritious, portable, food packet: a complete meal small enough to fit into a soldier's pocket. Ancel Keys quickly became an expert on nutrition.

**Ancel Keys:** If vitamins were missing from his food, the soldier might have to take concentrated vitamins. If he had vitamins but no food, he would still starve. The best way, naturally, is to supply vitamins in the food.

**Unidentified Speaker:** A chewing gum manufacturer assembled the K-rations, as the Army called the little packets in honor of their developer. Each waterproof box contained a tin of meat or cheese, biscuits, a chocolate bar and hard candy, coffee, lemon or soup powder, chewing gum, toilet paper, and even cigarettes.

**Unidentified Speaker 3:** It's good eating.

**Unidentified Speaker:** The Army was so impressed with the results that eventually all combat soldiers received K-rations. Even some non-combat troops lived for weeks on the monotonous diet of canned meat, crackers, and chocolate. A fact that disturbed Ancel Keys who wrote that, "It was no wonder the K-rations got a bad name." Late in the War, however, American troops fighting in Germany were happy to have anything to eat, even their K-rations. As war neared an end, Keys and others became concerned about the problems of starvation and the subsequent rehabilitation of Europe's devastated populations.

**Josef Brozek:** What do we do with starved people? What the difference in their recovery depending on how we would feed them. We had no idea. None. There was no information in the literature about what happens to people after prolonged starvation when you start refeeding them.

**Unidentified Speaker:** In a search for answers, Keys asked the War Department for permission to carry out semi-starvation experiments on humans. He suggested using conscientious objectors who, as he wrote later,

“were languishing in prison camps or doing trivial work.” The War Department granted permission for the unique experiment.

**Josef Brozek:** Actually, we had more volunteers than we could possibly use. These people who were conscientious objectors wanted to do something meaningful with their lives and this was a unique challenge.

**Henry Scholberg:** I knew that there were men out there in the battlefield who were dying. At the same time, I knew that there were people who were starving.

**Unidentified Speaker:** Thirty-six young men, most of them Quakers, Mennonites, or Church of Brethren members, moved into the south tower of the Memorial Stadium, which would be their home for over a year. Many took courses at the University, even as they grew thinner and thinner. The study consisted of three research phases: a period normal eating, the three months of semi-starvation, and a refeeding, or rehabilitation phase. During each phase, the men underwent, almost daily, biochemical, physiological, and psychological tests to study the effects of more or less food on the body.

**Henry Scholberg:** And what I wasn't expecting was the effect it would have on the mind; the total feeling of, I guess, depression, the total occupation with the idea of food. Somebody would say, “food for thought,” an expression like that, and they mentioned the word “food,” you know what I mean? I remember being a little bit critical of guys in the early part who would lick their plates. I thought that was really pretty crude, but by the time we were into about the

second month of it, I was doing it myself. You just needed every single calorie you could get your hand on. Then the other thing that we weren't expecting was how weak we became. I remember one time I was dating this girl and we were walking home from the movie, and I said to her, "You know, if we get attacked by a bunch of hoodlums, run like hell because I won't be able to help you." We lost our sex drive, and I told you I was dating this girl, and I never kissed her the whole time I was dating her. So sexually we were, you might say, dead.

**Unidentified Speaker:** The men's small meals during the semi-starvation period were designed to duplicate the food of Europe's occupied countries: root vegetables, dark bread, simple, starchy foods. The volunteers were required to walk at least 22 miles per week, either outside or on a treadmill. To ease hunger pangs, some of the men chewed as many as 50 packs of gum a day.

**Robert Villwork:** Oh, I was one of those that chewed an enormous quantity of gum, and they decided that it had too much calories per stick and they cut us down to two packs a day. I could live with that because that was a \*lot.

**Henry Scholberg:** Dr. Keys, he shocked us. He called a meeting and he said, "I'm sorry to report, but some of you are breaking training." In other words, some of us were cheating. A buddy system was established.

**Josef Brozek:** I was in charge to moderate the extra food intake that they would either get or that would be taken away. Believe me, this was a very,

very difficult job for me, not only from a human point, but of course many of these people were my friends. So when somebody's starving and you take away from the little that he has, that's a tough thing to do. Not only tough thing to take, but also tough thing to do.

**Unidentified Speaker:** Irritable, tired, and always hungry, the men marked their calendars, counting the days of starvation left until rehabilitation. Henry Scholberg, who is 6'1", weighed 112 pounds when he had his first real meal.

**Henry Scholberg:** I know I asked for macaroni and cheese and I ended up eating too much, went to the hospital and had to get my stomach pumped.

**Josef Brozek:** He overate. He ate too much and we almost lost him. He had to be hospitalized. His heart almost stopped. For me that was terrible because, I told you, I recruited the people and I felt deep, personal responsibility for each of them.

**Unidentified Speaker:** Ancel Keys shared the findings with international relief agencies and reported them to the scientific world in "The Biology of Human Starvation." The book remains a classic still relevant today. Throughout the years, study participants have stayed in contact with one another through letters and reunions.

**Henry Scholberg:** The best thing, probably, is the feeling afterwards that I had done something--I hesitate to use the word "noble," I'd rather just use the word "good."

**Ansel Keys:** It strikes without warning. Of 10 men, we can expect five to get it, but we can't say who, or when, or why.

**Unidentified Speaker:** When the war ended, Ansel Keys turned his scientific curiosity toward the new American plague, as he called it, coronary heart disease.

**Ansel Keys:** The facts are simple. You know the chief killer of Americans is cardiovascular disease: disorders and degeneration of the heart and blood vessels. Here are vital statistics. They show that this problem here in America is the worst in the world.

**Unidentified Speaker:** Keys was particularly struck by reports of the number of seemingly healthy executive men who were dropping dead of heart attacks. Was it job stress, as some suggested, or could it be something else? While it was understood by the mid-1940s that blocked coronary arteries caused heart attacks, no one understood the cause of the artery-blocking deposits. Dr. Keys proposed a study that would follow a large number of apparently healthy executives for many years, comparing the characteristics of those who had heart attacks along the way with those who didn't. It was the start of Keys' search for what later would be called risk factors for heart disease. During annual visits to the Laboratory of Physiological Hygiene, the executives received thorough testing and examination; sometimes on equipment designed and built right in the laboratory. A general interview assessed the men's lifestyles and changing habits.

**Ancel Keys:** Still like apples as much as ever?

**Unidentified Speaker 4:** Haven't got one in your pocket have you doctor?

**Unidentified Speaker 5:** See you again next year.

**Unidentified Speaker 6:** We hope.

**Unidentified Speaker:** After 40 years of follow up, 54 men out of 283 were still living. The most frequent cause of death: heart disease. The most common risk factor: smoking. Keys identified blood pressure and blood cholesterol as other risk factors that affected either the heart attack rates or the longevity of the executives. But even before this study began providing answers, Ancel Keys was thinking up more questions. This time the research would be much larger in scope and objective. Under Ancel Keys' leadership, the Laboratory of Physiological Hygiene had become an exciting and stimulating place to work for a number of promising young investigators.

**Josef Brozek:** This was a unique establishment. What we did was bring together different kind of competences dealing with human beings: the anthropology, biochemistry, psychology, medicine. All of this together in a closed, interacting team, and that was very new and very impressive to the people all over the world, and we had visitors from, literally, all over the world to come and see what makes it tick, what do we do, what's our thinking. I could not imagine more challenging place for me.

**Henry Blackburn:** It was a lived-in place. It was an intense place intellectually, and socially it was quite coherent.

**Unidentified Speaker:** Dr. Keys began a tradition that set an unusual tone for a research laboratory.

**Josef Brozek:** Each afternoon at 3:30 we gathered for tea. Everyone: the scrubbers of the floors, the Director. Everyone came and when people came from abroad, they could not believe the atmosphere that he created it. We were co-workers. That was the essence of the laboratory. Ancel was the creator of this aspect.

**Unidentified Speaker:** Those who worked with and for Ancel Keys found him demanding, but supportive.

**Henry Blackburn:** He was small, very muscular, Napoleonic in dimensions if not in character, very sharp, penetrating regard. Direct to the point of bluntness, critical to the point of skewering. Very focused and with a quick and a bright intelligence. He was just a very impressive fellow.

**Josef Brozek:** He was fair to everybody and to all the ideas. He was fair to the people and he was fair to the thoughts that people were bringing up. He would listen so that we were free--always free to come up with ideas.

**Unidentified Speaker:** Ancel and Margaret created a similar environment of intellectual curiosity at home with their three children: Carrie, Henry, and Martha, the youngest.

**Carrie D'Andrea:** It wasn't uncommon to have the dinner interrupted by somebody having to go get the encyclopedia and look something up. There

were discussions about parts of anatomy, of course, as we ate chicken or beef, and had to find the equivalent body parts among us on our own bodies.

**Unidentified Speaker:** In 1951, feeling that the laboratory was in the capable hands of his colleagues, Ancel and Margaret took the two oldest children to Oxford for a year's sabbatical. It was to be the first of Ancel's many extended trips abroad, sometimes with the whole family in tow, but nearly always with Margaret, a trained biochemist who traded full-time motherhood for laboratory fieldwork wherever in the world her husband's research took them. During the year at Oxford, the couple visited Naples, Italy, in response to a challenge by an Italian colleague. "Heart disease is no problem here," the doctor said, "come and see for yourself." Margaret set up a portable laboratory for measuring cholesterol. Ancel examined men and visited public hospitals where he could find almost no heart patients. It didn't take long to see that, indeed, working class Neapolitans had low serum cholesterol levels and low heart disease rates. Keys also observed that their diets were very different from American eating habits. The couple continued their travels, measuring cholesterols and conducting diet surveys in several European and African countries. Their findings strengthened Keys growing belief that a diet rich in saturated fats led to heart disease, but convincing doubting colleagues of this radical notion would be harder than he expected.

**Henry Blackburn:** At the first major meeting, to discuss these issues, that WHO called in 1955, Ancel put forward his ideas in his typically direct, let's say

blunt fashion, with great confidence, and was flabbergasted to find that his ideas were not accepted on the spot, and they were challenged in a way that only a distinguished British intellectual could do it. So George Pickering said something like this, “Yes, and Professor Keys would you be kind enough to cite for us the principle piece of evidence that you think supports this diet heart theory of yours?” And Ancel fell into a trap, he made a mistake; he cited a piece of evidence and they were able to destroy it. Instead of citing well, this theory’s based on a body of evidence that we’ve seen here and here from the clinic, from the laboratory, and from comparing populations, he didn’t make his case. He cited a piece--destroyed. He got up from being knocked to the ground and went out saying, “I’ll show those guys,” and designed the Seven Countries Study.

**Unidentified Speaker:** In spite of the skeptics, it was clear to Keys that a need was growing for a long-term, cross-cultural, comparison of populations.

Laboratory, clinical, and epidemiological findings all seemed to be pointing in the same direction. The time was ripe for a systematic study, so Keys prepared the design for an immense international collaboration unlike any undertaken to date. He wrote the grants and lined up colleagues around the world to work with him. The project to study 12,000 healthy, middle-aged men in seven countries began in 1958.

**Henry Blackburn:** The Mediterranean Basin was the first focus, and that consisted of Italy, Greek Islands, and Yugoslavia. The contrasting focus was

central Northern Europe, the Netherlands and Finland. The United States, and then one Asian culture, Japan. These were chosen because of their contrasting diet pattern primarily, and the relative uniformity of rural laboring populations.

**Unidentified Speaker:** The diet in the Mediterranean countries centered on fruits and vegetables, bread and pasta, and plenty of olive oil. Meats, fish, and dairy products were used as condiments, rather than as the focus of the meal. Finland was chosen for its high butter fat diet, the highest saturated fat diet of any country at the time. The Fins, in fact, were known to spread butter on their cheese. The Japanese were chosen for their remarkably low saturated fat diet. For consistency across countries, all participants came from rural areas or small communities. They ranged from men living in two Japanese villages to American and Italian railroad workers, examined in railroad cars that served as field laboratories, to farmers and laborers in areas of Crete, Italy, Yugoslavia, and Finland.

**Henry Blackburn:** There was no question about a \*Dalmatian farmer would not get into our quarters, and if there was any hesitation, the mayor was perfectly happy to intervene for us, not in any coercive sense, but “Come on, guys, this is a great thing. Come along; bring your wife and kids. They’ll examine you at the end of the day.” Yes, he chose people who were respected and had authority in the communities, and that made it work.

**Unidentified Speaker:** To standardize the findings, data from the seven countries were sent back to the laboratory in Minnesota for analysis. Every five years, Keys tallied up the number of people who had heart disease or had died of it in each country. The differences were dramatic.

**Henry Blackburn:** Basically, there turned out to be from five to 10 full differences in heart attack rate in men of this age between the Mediterranean Basin, northern Europe, U.S., and Japan. With Japanese and the Greek Islanders having the lowest rates of all. Finland and the United States having highest with parts of Yugoslavia and northern Italy and Holland in between. The Seven Countries Study demonstrated clearly the preventability of heart attacks, and that was a big deal because they were no longer considered natural aging phenomena, or acts of God, or genetically determined primarily. They were clearly preventable.

**Unidentified Speaker:** Some experts still weren't convinced.

**Jeremiah Stamler:** Some remained skeptical; a whole bunch of people remained skeptical. It's kind of ironic some of those distinguished cardiologists people finally convinced were for years roadblocks against public health progress. I will name no names in this area with whom we contended in various struggles to implement public policy to apply the knowledge already available. And of course that skepticism among a circle, you know, fewer and fewer in the cardiologist community was aided and abetted by certain commercial interests who didn't want to hear, you know, particularly from for years meat,

egg, dairy. The struggle for public health advance in this field didn't go on in any polite arena or vacuum. It went on in a real world that was rough and tumble.

**Unidentified Speaker:** The fact that heart attacks were preventable was big news in the medical and public health worlds, as well as in the media. "Time" magazine did a cover story on Keys and his research. "Mr. Cholesterol," as he was nicknamed, was becoming famous.

**Jane Brody:** When I became a health and science writer, way back in 1963, heart disease was something that just happened to Americans. It was epidemic in this country, but very, very few people had any idea as to why we had such a high rate of heart disease. I think it's basically the Seven Countries Study that really turned my head and helped me, as a reporter and as a public health oriented person, to convey the message to Americans that they can do something about heart disease.

**Russell Luepker:** I think what we've observed in the period that has followed, certainly due to the work of Dr. Keys and many others in the field around the world, is a peaking in the mid-1960s of heart disease, and a gradual fall. So people are living longer, and in essence, postponing severe disease which used to kill men particularly in their 50s.

**Unidentified Speaker:** The "Seven Countries Study" made Ancel Keys something of a research celebrity worldwide. He and Margaret traveled often, especially to the countries participating in the study, where they continued

their follow up and analysis work. But it was that first trip to Naples in 1951 that made a significant difference in the life of the Keys family, as well as the lives of many Americans. There they discovered the working class Italians delicious and healthy diet so different from the high fat, meat, and dairy based diet of most Americans. They decided to write a cookbook to share their discovery. "It was good fun," Ancel wrote later. Margaret developed the recipes, they wrote the book together, and published "Eat Well and Stay Well" in 1959. It was the book that built a house. Unexpectedly, it became an American bestseller, the profits substantial enough to enable the Keys to build a second home outside of Naples. The couple wrote two more books that continued to promote healthy eating through the Mediterranean diet.

**Jane Brody:** Ancel Keys research actually brought the Mediterranean diet to the American public for the very first time. Now, I don't think they were ready for it at that time, but I think now many more people are ready for it. You see it in the major supermarkets now because what's happened in supermarkets? The produce section has become much larger and much more beautiful, and carrying foods that we never saw when I was growing up. Probably the most clipped columns of mine by readers are the ones that show food pyramids, and the food pyramid I've done of the Mediterranean diet and the Asian diet are posted on peoples' refrigerators all over the country.

**Unidentified Speaker:** On March 17th, 1991, Ancel and Margaret were at their home in Italy when tragedy struck the Keys family.

**Carrie D'Andrea:** In talking about my parents, one of the things that's so important to remember is that in some ways we lived quite a charmed life. At an early age we were exposed to people from all over the world. My sister was the baby of the family and nine years younger than I, and she especially got the benefit of all the early traveling and exposure because as their work expanded internationally, her being that much younger she got much more exposure to it. And I think sometimes she was the apple of their eye, coming later in life and being an unexpected member of the family.

**Unidentified Speaker:** The Keys' daughter Martha, her husband Harvey, their two young sons, and Carrie's daughter were vacationing in Jamaica.

**Cassie D'Andrea:** Unfortunately, the day after they arrived in Jamaica, my sister was murdered and my brother-in-law shot. They were both shot while on the beach, right on front of the house where they were staying. My daughter was sitting on the porch and saw the gun's flash, could not see what was happening, it was pitch black. Why they were shot and my sister murdered we do not know. There are several theories about that. I was terribly worried. I thought that this kind of thing would be more than my parents could bear, but I should have known better, that they are resilient and although suffering a great deal of pain at that loss and still feeling it, were able to talk and enjoy Martha's life and what she left for us, and Harvey and the children are a constant part of our lives, and so we have that reminder with us.

**Unidentified Speaker:** As Ancel Keys, at 97, looks ahead at the work still left to do, others are looking back at the Minnesota Physiologist and his seven decades of pioneering research.

**Henry Blackburn:** It was a new approach to physiology. He did regression equations. He applied mathematics to the relationships between body height and weight, between diet and blood fats, between blood fats and heart attack rates, between diet and heart attack rates. He put it all together in a quantitative sense, developing one of the main goals of science, predictive equations--the Keys Equation. He discovered for our culture the Mediterranean diet and lifestyle, which has been the most profound influence on public health and eating patterns in western culture. He found for us that population causes in contrast to the individual causes of heart attacks and strokes, and is as natural in the course of a investigative life as someone who's aging. He's now making a contribution to prediction of longevity and survival through these things, sort of quantitative approaches.

**Russell Luepker:** Dr. Keys is obviously one of the brighter lights of the University of Minnesota. There are many others who've contributed, but in health, he is the one of the luminaries. I think it's important to note that his work continues here. We live partly on a very wonderful history of high quality work by a very brilliant man.

**Carrie D'Andrea:** Most of the time I forget that he's famous or well-known, and I continue to be somewhat taken aback and a little bit embarrassed when

somebody says, “Oh, your father is Ancel Keys.” You’d think that I would have gotten used to it by now, but I don’t, and I think that speaks to the very humble people that they are. That they go about their passionate life doing research without seeking glory, wanting people to say, “Here, look at me,” but rather, “Here, look at the research we’ve done. Make use of it. Make the world a better place. That’s what it’s all about.”